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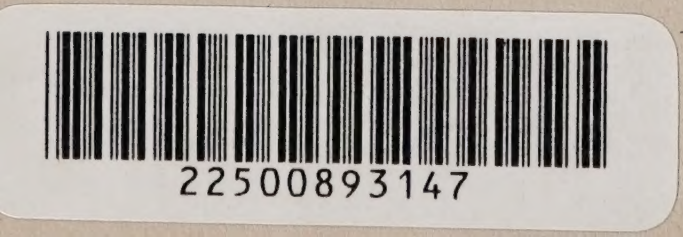

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# THE HEART REFLEX AND THE MECHANISM OF ANGINA PECTORIS.

By ALBERT ABRAMS, A.M., M.D.,

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Before discussing the mechanism of angina pectoris it will be necessary to refer to certain preliminary facts concerning the heart reflex.

Attention was first directed[1] in 1898 to the phenomenon now known as the heart reflex. The reflex in question is a contraction of the myocardium of varying duration, which results when the skin of the precordial region is irritated. The cutaneous irritant may be a spray of ether directed over the region of the heart or the skin may be rubbed with a blunt instrument or by means of an ordinary pencil eraser or by a series of percussion blows. The nearer the irritant is applied to the precordial region and the more vigorous the cutaneous friction, other things being equal, the more pronounced is the heart reflex. The reflex is best observed with the Roentgen rays with the fluorescent screen approximating the anterior chest wall. The reflex is, as a rule, more manifest in the left than in the right ventricle, and the contraction of the myocardium is not always sudden and of momentary duration; on the contrary, its duration in children on whom most of the original observations were made is not less, as a rule, than

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two minutes, and, furthermore, the myocardial recession continues even after the source of cutaneous irritation is removed. The degree of myocardial recession (heart reflex) varies greatly. In some persons it is scarcely perceptible, while in other individuals the heart may recede more than two centimeters on

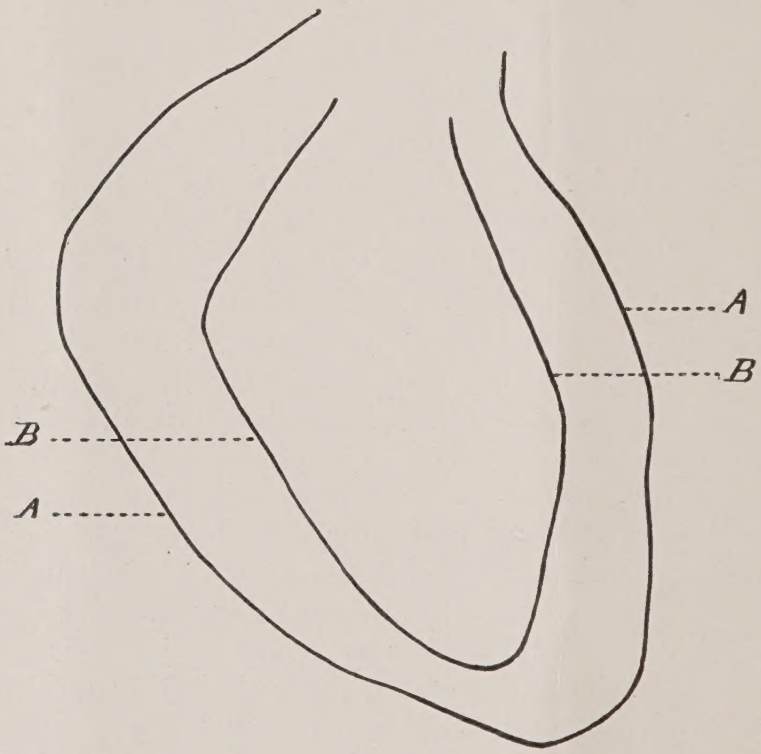


FIG. 1.—Heart reflex in a boy, aged 8 years. Duration of reflex, 2½ minutes. The normal outline of the heart drawn on the fluoroscope is represented by A, whereas B represents the outline of the heart after cutaneous irritation and shows the degree of myocardial recession or the heart reflex.

either side upon the first application of the cutaneous irritant. (See Fig. 1.)

In other instances, although the reflex is rarely absent in the norm, it is strictly confined to the left ventricle, as shown in Fig. 2.

In individuals with dilated hearts the reflex is

very evident and is of very much longer duration than in healthy hearts. This latter observation, as we shall learn presently, has been confirmed by the careful observations of Merklen and Heitz.

In the original communications concerning the heart reflex, the latter was observed only in the transverse cardiac diameter, but with the *x*-rays it can also be seen in the sagittal diameter. Subse-

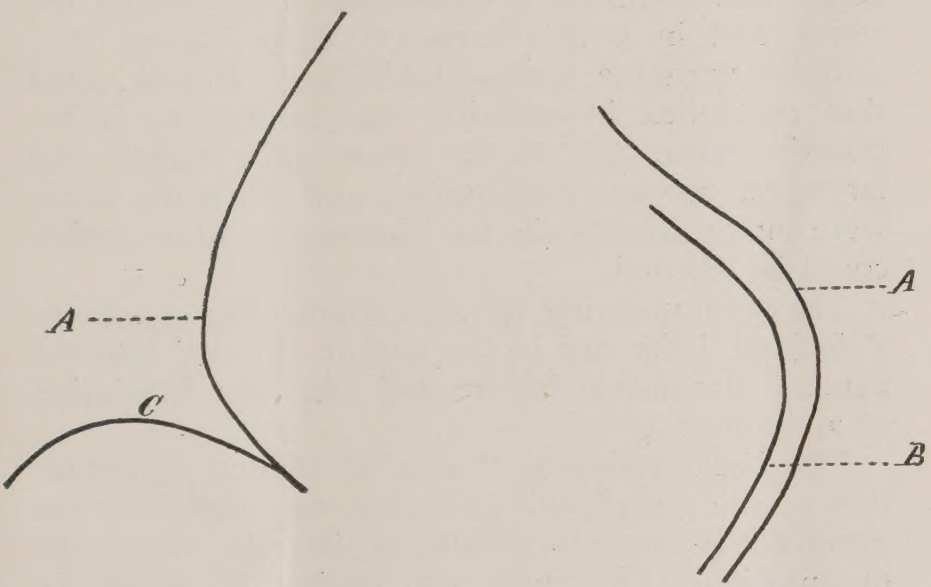


FIG. 2.—Heart reflex in a boy aged 14 years. Duration of reflex, 15 seconds. A represents the cardiac outline before, and B after, cutaneous irritation, while C represents the upper border of the liver.

quent observations demonstrated that the heart reflex could be elicited by irritation of more remote regions, viz., (1) by irritation of the nasal mucosa; (2) by irritation of the gastric mucous membrane; (3) by irritation of the rectal mucosa; (4) by irritation of the esophageal mucosa in the act of swallowing; (5) by percussion of the muscles; (6) by psychic irritations; (7) by vertebral concussion.

*Irritation of the Mucous Membranes.*—Here in-

vestigations were conducted during the time the *x*-rays were traversing the chest, and by means of the fluoroscope the heart was directly observed. It was noted that when irritating vapors were inhaled there was a decided recession of the cardiac ventricles (heart reflex), especially the left, and that this heart reflex was more pronounced than when excited through the skin of the precordium. Ether and chloroform inhalations also excited the reflex and in a few instances these vapors produced a veritable cardiac inhibition. It was noted that the reflex in question was excited by irritation in succession of the nasal, pharyngeal, and laryngeal mucous membranes, and when the latter were made anesthetic by cocaine no heart reflex could be elicited.

The accompanying sphygmogram (Fig. 3) shows a decided difference in the output of blood into the general circulation before and after the inhalation of ammonia:

The heart reflex may also be elicited by irritation of the gastric mucosa when the sponge of the gyromele is made to revolve against the membrane in question. One may also excite the reflex by irritation of the rectal mucosa by means of the finger in the rectum.

*Percussion of the Muscles.*—If one percusses the muscles (*tapotement*) of the extremities one can elicit cardic reflex. The latter is essentially a reflex of muscular origin exclusively, as such a reaction does not follow irritation of the skin of the extremities or percussion of the bones. Percussion of the muscles of one arm only suffices to elicit this reflex. Another curious feature of this myopathic heart reflex is that it causes retraction of the right heart ventricle only, the left being

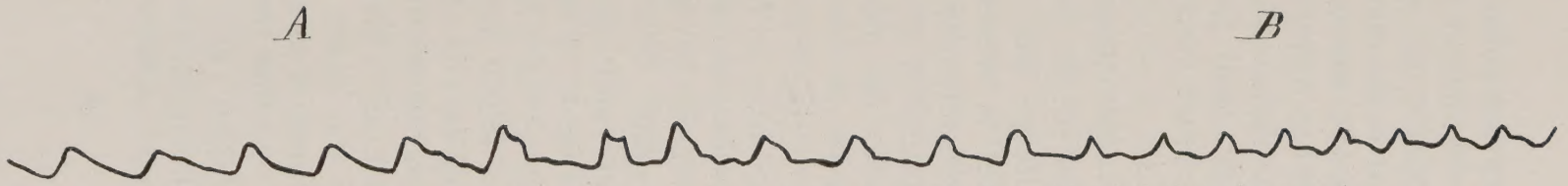


FIG. 3.—Sphygmogram of the radial artery A before, and B after, the inhalation of ammonia.

uninfluenced. Placing the subject before the *x*-rays this reflex is at once evident. After the heart borders are defined, request an assistant to percuss the muscles of one arm by means of a percussion hammer. Following the maneuver the right ventricle shows considerable retraction. The effect on the systemic blood pressure by percussion of the muscles is very slight, and this is obvious, considering that the left heart ventricle is uninfluenced by the maneuver.

*Psychic Irritation.*—We have always recognized the effects of emotions in the heart, but no tangible evidence of such effects has been demonstrated. The epigram of Peter is worth repetition: "The physical heart is the counterpart of a moral heart." The conventional expression of the frightened individual, "my heart was in my mouth," finds justification by an *x*-ray study of the heart. Inform the patient standing before the rays that you are going to burn him with a hot iron or frighten him in some other way, and the effect on the heart is at once manifest. It is a veritable psychic heart reflex implicating the entire organ. The heart becomes very much reduced in size, and appears as if it were retreating towards the neck. I know of no irritation, cutaneous or otherwise, that is so pronounced as is this psychic factor of fright in inducing the heart reflex. The foregoing fact is of the utmost importance in eliminating emotional influences in the treatment of cardiac diseases. Even in an ordinary *x*-ray examination of the heart one may observe in nervous patients a reduction of the heart mass. Mr. Bezley Thorne[2] observed that the heart shrank after exposure to the Roentgen rays. It is evident that the shrinkage thus observed was naught else but a cardiac reaction (heart reflex) to emotional in-

fluences, for an *x*-ray examination to the average patient is a momentous procedure. I have frequently witnessed the pulmonary reaction of fright: the lungs become hyperresonant on percussion, and the superficial areas of cardiac, hepatic, and splenic dullness become diminished, a condition which was called the *psychic lung reflex of dilatation.*[3]

The latter psychic reflex may be easily demonstrated if the areas of the organs in question are first outlined, and later, if the patient is frightened, percussion will demonstrate that the areas of the organs are reduced in proportion to the psychic reaction which provokes a dilatation of the lungs.

*Vertebral Concussion.*—Heretofore only one heart reflex was recognized, viz., the heart reflex of contraction, but when the spinal processes of the eighth, ninth, tenth, eleventh, and twelfth dorsal vertebræ are rapidly concussed in succession there is a decided increase in the area of cardiac dullness as obtained by percussion. This increase in the area of cardiac dullness is not associated, as the *x*-rays show, with any increase in the diameters of the heart. The latter fact corresponds with the investigations of Kornfeld,[4] who demonstrated that the heart muscle possesses the property of increasing the size of its cavities without any corresponding augmentation of tension of its walls, a condition which he calls *Ausweitungsfähigkeit.* By concussion of the spinous process of the seventh cervical vertebra, one may also provoke the ordinary heart reflex of contraction.*

*The writer has reported other vertebral reflexes, but as yet the profession has given to them only inconsiderate attention. Such reflexes are of undoubted value in diagnosis and treatment and are unconsciously evoked by the manipulations of the osteopath who seems to have monopolized this field of vertebral therapy. Anyone who has

*Practical Value of the Heart Reflex.*—Percussion of the heart, or, for that matter, any other organ adjacent to the lung, is associated with many errors, unless one takes into consideration the lung reflex. Percussion of the heart, as executed ordinarily, yields an absolute or superficial, and a deep or relative dullness. Practically little or no value can be attached to the superficial dullness in estimating the size of the heart, as it varies with the position of the overlapping lung borders. Even the lightest percussion blow will provoke sufficient cutaneous irritation to induce the lung reflex of dilatation, *i.e.* an acute dilatation of the lungs which may diminish the area of superficial cardiac dullness, even to obliteration. Cabot,[5] in his classical book, makes the following observation: "Anyone who has demonstrated an area of percussion dullness to many students in succession must have noticed occasionally that the more we percuss the dull area the more resonant it becomes, so that those who last listen to the demonstration, the difference which we wish to bring out is much less obvious than to those who heard the earliest percussion strokes. Abrams has referred to this fact under the name of the *'lung reflex.'*" Sahli, in his "Diagnostic Methods," refers to the same fact. The mere influence of room temperature materially changes the results of percussion. Let any one, after percussing the areas of superficial dullness, direct a current of cold air, *e.g.* from an atomizer, over the regions percussed, and

reason to doubt the value of manual manipulation of the spine may attempt a maneuver which I have only recently observed. While palpating, say the radial pulse, make firm pressure at the vertebral exit of the spinal nerves (preferably at the side of the upper dorsal vertebræ) and one will note a decided alteration in the character of the pulse, which often amounts to inhibition of the latter.

the result will be diminution or obliteration of the areas in question. It is evident from what has preceded that, while the heart reflex can always be determined by the *x*-rays, after cutaneous irritation of the precordium, mere percussion of the superficial area of cardiac dullness cannot determine its existence because the irritation necessary to evoke the heart reflex will also induce the lung reflex, which must necessarily mask the heart reflex.

Thus the observations of Schott and others, who seek to demonstrate the effects of carbonated baths on the heart by percussion of the latter organ are

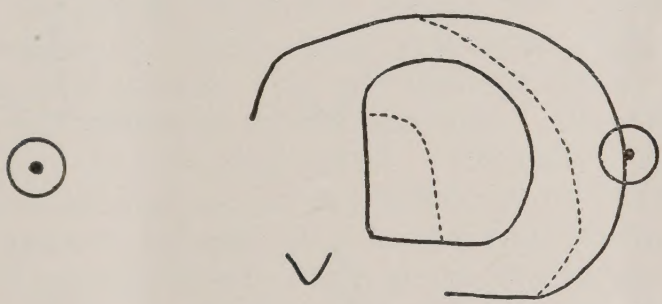

FIG. 4.—Cardiac reflex in a neurasthenic with functional troubles of the heart; reduction of the absolute and relative dullness. (After Merklen and Heitz.)

evidently erroneous unless such percussion takes into consideration only the deep or relative cardiac dullness. Heitler[6] perpetrates the same error by failing to take into consideration the coincident lung reflex when making cutaneous irritation. Heitler seeks to determine the sufficiency of the heart muscle by a series of percussion blows over the heart region. If, thereafter, the cardiac dullness is much diminished, it is an evidence, he argues, that the cardiac musculature is sufficient, for the tendency of the normal muscle tonus of the heart is to maintain a limited patch of dullness. As before remarked, the

heart reflex can be observed directly with the rays, but if strong percussion is employed so that reliance is alone placed on the deep or relative cardiac dullness, the reflex in question may be determined by percussion. Heitz,[7] in discussing "Le Reflexe Cardiaque d'Abrams," observes that, while in the normal subject the heart reflex is of short duration, in cardiectasis it may persist for several hours. In the

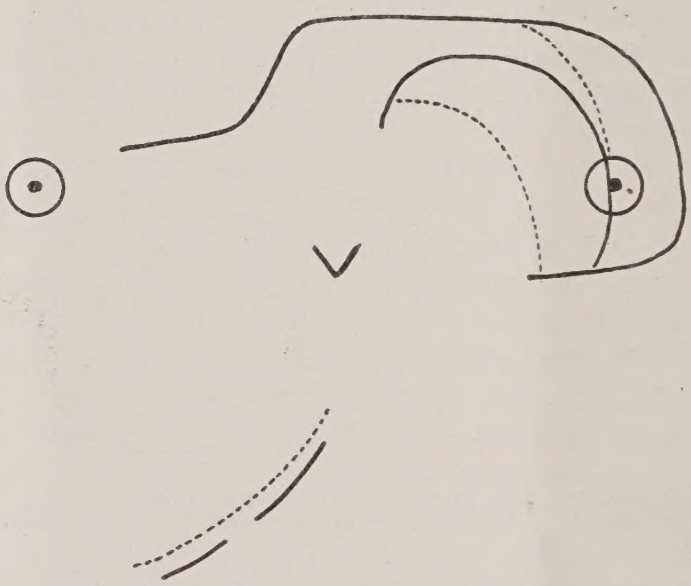

FIG. 5.—Hyposystole in an arteriosclerotic; reduction of the absolute and relative cardiac dullness and ascension of the inferior border of the liver under the influence of precardial massage. (After Merklen and Heitz.)

third edition of their valuable book ("Examen et Séméiotique du Cœur"), Merklen and Heitz show graphically the effects of friction of the skin in the region of the heart of a cardiac neurasthenic (Fig. 4), and in a cardiopath with hyposystolie (Fig. 5).

In Fig. 5 the reduction of the hepatic dullness is shown following the friction of the skin; the continuous lines show the superficial and the deep

dullness of the heart before, and the interrupted lines the reduction of the areas after friction of the skin.

All physicians do not possess equal skill in determining the relative cardiac dullness, and I have devised a simple apparatus called the "Vibrosuppressor,"[8] which serves to simplify topographical percussion. If one percusses the normal chest, say beneath the clavicle, a sound is produced which is the product of the vibration of the lung tissue and the thoracic walls. It is the summation of this vibration which interferes with the elicitation of the dullness of the airless organs in juxtaposition to the lungs. If the vibration in question can be eliminated, the definition of the viscera will prove easy of attainment. Briefly, lung resonance is made up of two chief factors, viz., vibration of the air in the lungs and vibration of the sternum. The latter is essentially a sounding-board. Thoracic vibration can be eliminated as far as possible by percussion of the organs at the end of a forced expiration, when there is comparatively little air in the lungs to vibrate and by suppressing the vibrations of the sternum by means of the vibrosuppressor (Figs. 6 and 7).

The apparatus is modeled after a tourniquet, consisting of a pelote, screw, band (6 cm. wide) and clamp for fixing the latter. It is so applied that the pelote rests on the xiphoid cartilage of the sternum. The pelote is made to compress the cartilage by aid of the screw with all the pressure the patient can tolerate. Percussion is then executed during the time the apparatus is employed and preferably during suspended respiration, after forced expiration. In the absence of the apparatus, firm pressure made on the lower end of the sternum by the hand of an assistant will aid topographic percussion during the

time the patient has suspended respiration after forced expiration.

*The Heart Reflex of Nasal Genesis.*—Reference has already been made to the fact that the heart reflex can be provoked by irritation of the nasal,

FIG. 6.—The vibrosuppressor.

pharyngeal, and laryngeal mucous membranes, and that if the irritation is sufficiently prolonged and violent the movements of the heart may be inhibited. If the membranes in question have been previously cocainized the heart reflex cannot be elicited. It is evident, then, that previous cocainization of the

nasal and pharyngeal mucous membranes should precede the employment of an anesthetic. On theoretical grounds, the laryngeal mucosa should not be

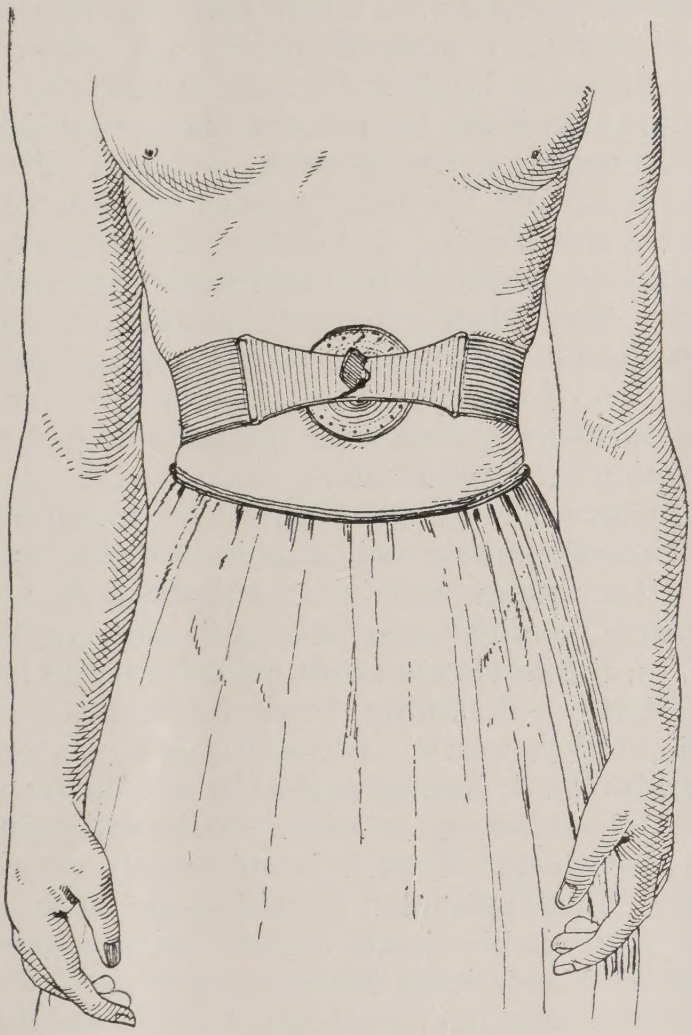

FIG. 7.—Application of the vibrosuppressor to the chest.

cocainized, as it is necessary to preserve the laryngeal reflex to prevent the entrance of foreign substances into the larynx.

*The Heart Reflex of Gastric Genesis.*—Knowing

that irritation of the gastric mucosa will provoke the heart reflex, it is not improbable that sudden death of gastric origin may be caused by reflex inhibition of the heart. In instances of this kind the fact of a dilated stomach directly compressing the heart cannot be ignored. I have studied, by aid of the *x*-rays and the fluoroscope the action of a dilated stomach on the heart by artificial distention of the stomach. The healthy heart can tolerate considerable compression and dislocation without modifying the intensity of the heart tones, but when the organ is diseased, the slightest compression and dislocation is followed by evil consequences. Artificial insufflation of the colon will also compress and dislocate the heart, but never in the same degree as will insufflation of the stomach.

*The Heart Reflex of Rectal Origin.*—Irritation of the rectal mucosa will also induce the heart reflex. Straining at stool in elderly people by increasing intraabdominal pressure, and thus putting a strain on the cerebral vessels, predisposes to rupture of the latter. Straining, however, is not wholly a question of pressure. Some patients, particularly those with weak hearts, suffer from collapse symptoms while straining at stool. In investigating the cause of such symptoms, I found that contraction of the abdominal musculature will cause even in the norm a veritable heart reflex with diminished output of blood from the left ventricle. For the latter reason the amount of blood is decreased in the arterial system and increased in the veins. The accompanying sphygmogram (Fig. 8) illustrates the effects of contraction of the abdominal musculature on the heart.

It is evident that if the heart is enfeebled the effects of such cardiac inhibition may be attended with

serious results. It is well known that different nerves from the abdomen and intestine are in close communication with the cardioinhibitory center in the medulla and that reflex inhibition of the heart can be easily produced in the frog by tapping a loop of the intestine with the handle of a scalpel. Severe abdominal affections, like peritonitis and appendicitis, are frequently attended with symptoms of heart collapse, owing, no doubt, to reflex inhibition of the heart.

Anyone can appreciate the inhibitory influence on the heart by contraction of the abdominal muscles, by palpating the radial pulse while straining at stool.

*Relative Valvular Insufficiency.*—The normal heart can easily adapt itself to the average grades of dilatation such as occur during exertion; in fact, the size of the cavities of the heart varies even in health, and a dilatation is physiological as long as the heart cavity is capable of emptying its contents during systole. What is called "getting wind" in climbing a mountain or in athletic training is practically a moderate dilatation of the cavities of the right heart. In relative valvular insufficiency the valves are normal, but they are no longer capable of completely closing the orifices of the heart. This condition is frequent after heart strain and involves particularly the tricuspid valves. A murmur which is heard in such instances may be made to disappear temporarily by inducing the heart reflex, which, by causing myocardial contraction, reduces the size of the cardiac orifices, thus enabling the valves to close the openings. Here the excitant of the heart reflex must be vigorous and for this purpose the sinusoidal current, with both electrodes to the precordial region, is most efficacious. Percussion of the pre-

cordial region with a percussion hammer will often suffice.

*Pericardial Effusion.*—The differential diagnosis between a dilated heart and a pericardial effusion is often conceded to be a difficult clinical problem. From what has preceded we see the heart reflex can be employed in diagnosis. The reflex in question is absent in pericardial effusions and present in cardiectasis. In other words, after the heart reflex is provoked the area of deep cardiac dullness will be uninfluenced in effusions but modified in cardiectasis.

It may be difficult to say whether a pulsating intrathoracic mass examined with the *x*-rays is the heart or an aneurysm. A retraction of the mass after provoking the heart reflex would indicate that it is the heart and not an aneurysm. Cooper utilized the foregoing fact in differential diagnosis. I will not attempt to discuss the therapeutic value of the heart reflex, but it is my personal opinion that the carbonated baths in the Schott treatment possess no special effect beyond their action in provoking the heart reflex by cutaneous irritation and that cutaneous friction by any other method is equally efficacious. The foregoing conclusion is formulated only as a result of many years of observation. Massage of the precordial region or the employment of the sinusoidal current, especially in cardiopaths, will reduce the area of the heart and the pulse-rate and augment blood-pressure. The now prevailing fetish in cardiotherapeutics is Nauheim. I subscribe equally to the efficiency and deficiency of this famous resort, but it is puerile to endow its waters with marvelous attributes.

*Angina Pectoris.*—Among the theories of angina, that of Allan Burns appeals most cogently to rea-

son. The latter assumes that, in consequence of a transient ischemia of the heart-muscle caused by disease or spasm of the coronary arteries, a condition analogous to intermittent claudication ensues. It is known that the coronary arteries are practically always diseased in fatal cases of angina, but if we accept the observation of Schäfer that the coronary vessels are unprovided with vasomotor nerves, the theory of intermittent claudication of the coronaries must necessarily suffer a serious setback unless supported by other evidence. The coronary arteries supply the heart with blood only during diastole, for during systole the ventricular

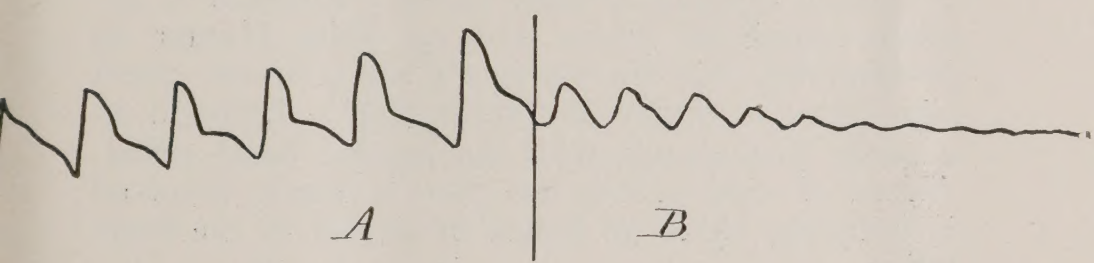


FIG. 8.—Sphygmogram (A) before and (B) while straining at stool.

wall is so strongly contracted that the muscular tension becomes greater than the coronary pressure and so the coronary artery and branches are compressed and the blood is driven back into the aorta. It is our contention that the theory of Burns is correct, but that the ischemia is quite independent of the coronary arteries, which are merely passive structures. We assume that any factor operating to augment the tonicity of the cardiac musculature compresses the arteries in question and thus induces ischemia. The heart reflex is essentially a myocardial contraction and when the reflex is in evidence the coronary arteries are subjected to varying degrees of pressure. If in an attack of angina,

the pulse shows augmented tension and is small and perhaps diminished in rate, or if syncope is observed, such symptoms are explainable by the heart reflex.

We know that when the reflex is in evidence, the heart is practically inhibited; there is a diminished output of blood into the general circulation and, if the pulse shows increased tension, it is only an expression of vasomotor activity which assumes the burden of maintaining the circulation.

If one studies the etiology of angina, one notes that the factors which precipitate a paroxysm are also equally operative in inducing the heart reflex. Muscular effort is a potent factor which also provokes the myopathic heart reflex. Emotion is another prominent factor and led John Hunter to observe that "his life was in the hands of any rascal who chose to annoy and tease him." Emotion as a cause corresponds with the psychic heart reflex. A gust of wind striking the chest is equally involved in inducing either an attack of angina or the heart reflex.

Oliver demonstrated that patients who have suffered from precordial pain obtain permanent relief on the supervention of cardiac dilatation and failure, and Broadbent has shown that the supervention of mitral insufficiency may diminish the tendency to anginoid attacks.

Now, in cardiectasis, while the heart reflex can be provoked, the cardiac musculature is enfeebled and the resulting pressure on the coronary arteries is correspondingly diminished. Reference has been made to the heart reflex of dilatation and in several instances, during my office hours, I have inhibited anginoid pains by concussion of the vertebræ which induces cardiac dilatation, and I have employed the same method with fairly good results in

the treatment of angina pectoris. In other instances, I have unintentionally provoked attacks of angina in studying the heart reflex and the methods for its elicitation.

By means of the heart reflex, one can easily comprehend the attacks of false angina. In functional

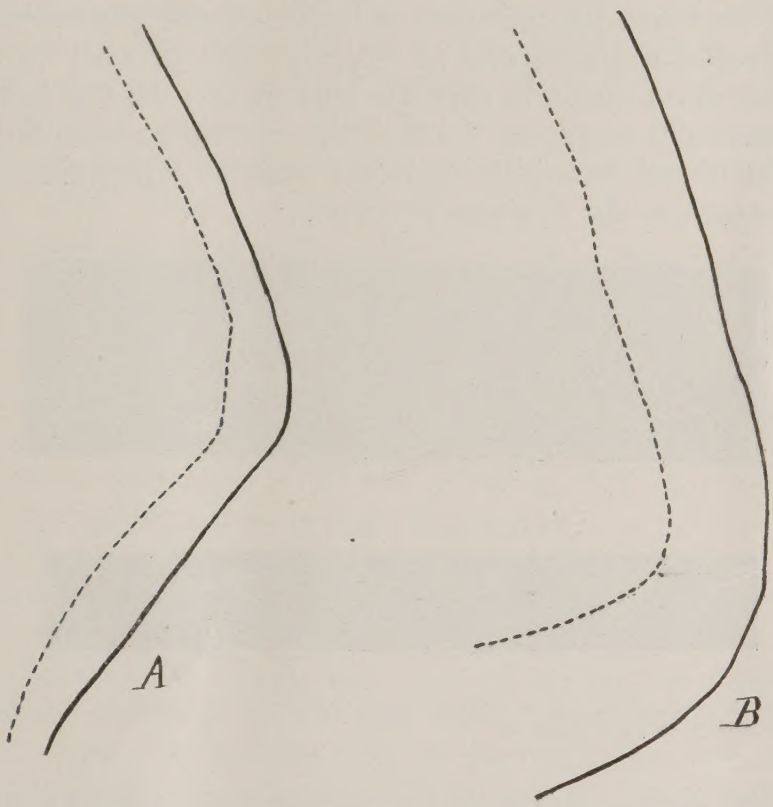


FIG. 9.—The heart reflex, A before, and B after, the use of digitalis.

angina, the heart reflex is always accentuated as I have assured myself by repeated *x*-ray examinations. In cardiodynia (*Herzangst*) observed in neurotics, one is dealing essentially with a psychic heart reflex.

There are etiological factors concerned in angina which on first view could find no explanation by my heart reflex ischemic theory, yet on reflection, the

theory is applicable. Thus, one of my friends, a physician in Paris, suffers like several other members of his family from pronounced attacks of angina pectoris several hours after the use of coffee, tea, or tobacco. One knows, for instance, that the effect of caffeine in small doses on the cardiac muscle is to increase its activity; in larger doses, it produces phenomena analogous to fatigue, and in very large doses, the muscle is thrown into rigor. In the latter instance, the strong contraction of the myocardium (which is essentially a heart reflex) mechanically compresses the coronary vessels.

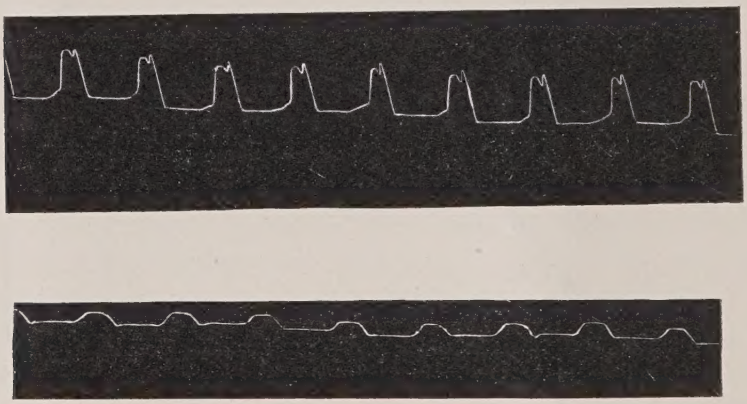

FIG. 10.—A, Tracing a normal anterior tibial artery; B, tracing o same artery in claudication.

The toxic factor here involved in eliciting the heart reflex is necessarily delayed and cannot be immediate like the other factors concerned in the elicitation of the reflex in question. Digitalis and other circulatory stimulants may provoke an attack of angina for the reason that they augment the tonicity of the cardiac musculature. Digitalis increases the amplitude of the heart reflex as shown in Fig. 9.

Recently I have observed the following singular phenomenon: After placing the ankle of one lower

extremity on the knee of the other extremity, the pulse of the anterior tibial artery is easily palpated. Next, direct the patient forcibly to extend and flex his foot (the leg occupying the same position) a number of times in succession. If the tibial pulse is again sought, it will be either very feeble or absent. In the norm fully 30 seconds may elapse before the pulse has attained its former volume. The blood-pressure also falls. In a patient with claudication, five minutes elapsed before the tibial pulse resumed its former volume. This test may prove of value in the diagnosis of the latter affection. I assume that the tibial artery, immersed as it is in a muscular atmosphere, responds reflexly to the muscular contractions, and in arteriosclerosis the longer duration of the arterial contraction accounts for the phenomena of claudication. Here, as in my heart reflex theory of angina, the ischemia is dissociated with vasomotor action, insomuch as when amyl nitrite is inhaled, obliteration of the tibial artery is effected by the muscular maneuver suggested.

The treatment of angina pectoris includes the elimination of all factors concerned in the elicitation of the heart reflex. The value of amyl nitrite inhalation in the treatment of a paroxysm is universally conceded. When the latter drug fails, and it often does, the failure may be attributed to irritation of the nasal mucosa which induces the heart reflex, which would still further accentuate the paroxysm. In such instances and, in fact, in nearly all instances, the action of the drug in question is aided by previous cocainization of the nasal mucosa, which eliminates the irritant factor in amyl nitrite inhalations. Concussion of the lower dorsal vertebræ (daily treatment) should be given a trial in the treatment of angina pectoris to induce the counter-reflex of dilatation.

## BIBLIOGRAPHY.


1. Abrams: MEDICAL RECORD, March 26, 1898.
2. Thorne: *British Medical Journal,* Vol. II., p. 1238, 1896.
3. Abrams: *American Medicine,* July 16, 1904.
4. Kornfeld: *Zeitschrift f. klin. Med.,* Bd. XXLX.
5. Cabot: Physical Diagnosis, page 76.
6. Heitler: *Wiener klin. Woch.,* 1890, and *Zeitschrift f. d. ges. Ther.,* 1893.
7. Heitz: *La Presse Médicale,* 19 Juin, 1907.
8. Abrams: *La Presse Médicale,* 6 Février, 1907.